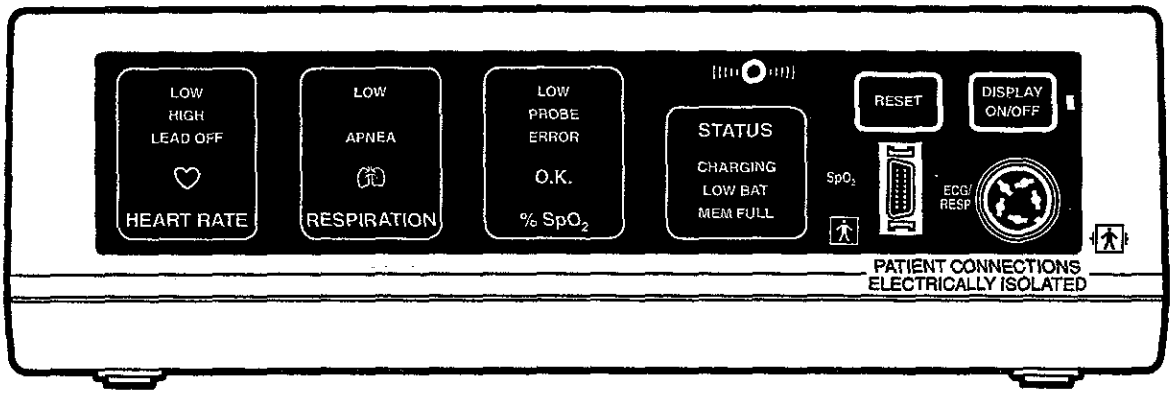
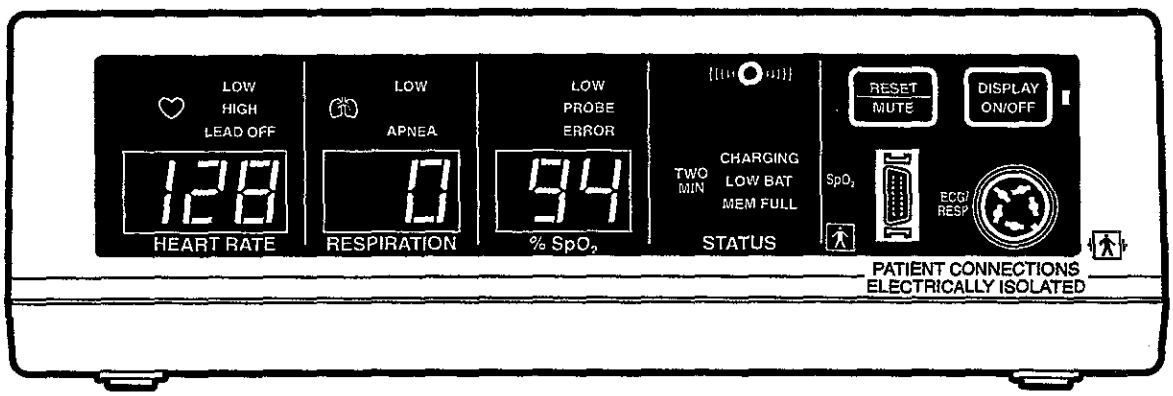
Model 510/511

MONITOR

SERVICE MANUAL P/N 21-02-0069 REV. 03 7/01



Model 510



Model 511

CAS MEDICAL SYSTEMS, INC.
TECHNOLOGY APPLIED TO MEDICINE

AN IMPORTANT NOTICE FOR APNEA MONITOR USERS

Dear Valued Customer,

CAS Medical Systems, Inc. is pleased to announce their acquisition of the Corometrics® Event-Link® Monitoring System product line from GE Medical Systems. The sale includes the complete line of Infant and Adult Apnea Monitors and Accessories for hospital and home use as well as the Event-Link® Software for data retrieval and display.

You may find product labeling and contact information reference Corometrics by name and contact information. Corometrics part numbers/catalog numbers will be called out as well. Please be assured that CAS Medical Systems will recognize these part numbers and provide accurate reorder service to you.

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AUTHORIZED REPRESENTATIVE IN THE EUROPEAN UNION

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Phone: 49 4502 880 557
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CAUTION: In the United States of America, Federal Law restricts this device to sale by or on the order of a Physician.

WARRANTY

CAS Medical Systems, Inc. warrants the monitor, when new, to be free from defects in material and workmanship and to perform in accordance with manufacturer's specifications for a period of (1) years from the date of original purchase from CAS or its authorized distributors or agents.

The same warranty conditions are made for a period of (1) year with respect to non-disposable accessories and associated equipment. CAS Medical warrants fuses, patient cables, lead wires, electrodes, and remote alarm cable for out-of-box failure only.

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PREFACE

ABOUT YOUR MONITOR

The Corometrics Model 510/511 monitor provides real time monitoring of heart rate and respiration, and will alert the user if specific abnormalities are detected. Detected abnormalities are indicated both visually and audibly. The basic Model 510/511 can be optionally equipped to measure and monitor SpO_2 — the functional oxygen saturation of arterial hemoglobin.

This manual is written for the Model 510/511 equipped with SpO_2 — therefore some sections, or part of sections, will not apply if your monitor is not equipped with SpO_2 monitoring capabilities.

If your monitor is not equipped with SpO_2 monitoring capabilities, the SpO_2 connector is not installed on the front panel; in addition, the % SpO_2 area on the front panel is not shown.

In summary, the Model 510/511 allows you to start with a basic monitor and add SpO_2 monitoring capabilities as your clinical needs require and your budget allows. Contact your Sales Representative for more information regarding Model 510/511 upgrade information.

INDICATIONS FOR USE

The Model 510/511 monitor is intended for monitoring the following in infants: SpO_2, heart rate, respiratory rate and the detection of central apnea. The Model 510 is for homecare use only. The Model 511 is for hospital use only.

⚠ **WARNING:** The Model 510/511 monitor detects ***only*** central apnea in infants; it does not detect mixed or obstructive apnea.

The Model 510/511 uses the following clinical methods to detect heart rate, respiratory rate, central apnea, and low SpO_2:

To detect heart rate, electrodes are placed on either side of the patient's chest. These electrodes detect the signal caused by electrical changes produced by the heart. The heart rate is computed on a beat-to-beat basis using the time interval between R-R peaks.

To detect respiratory rate, electrodes are placed on either side of the patient's chest and electrical signals are obtained via the transthoracic electrical impedance technique. From the electrical signals, calculated breathing rates and respiratory waveforms are derived.

Central apnea is directly related to respiration. Central apnea is detected when a breath does not occur within the predefined time delay.

To monitor pulse oximetry (SpO_2) a Nellcor sensor applied to a patient's extremity uses the principles of spectrophotometry and plethysmography to measure the absorption of selected wavelengths of light to determine the functional hemoglobin that is saturated with oxygen.

⚠ SAFETY INFORMATION

The **DANGERS, WARNINGS** and **CAUTIONS** that appear throughout this manual are preventative measures designed not only to uphold the safety of both patient and operator, but also to enhance equipment reliability. The definitions of **DANGER, WARNING** and **CAUTION** in this manual comply with ANSI Z535.2, American National Standard for Environmental and Facility Safety Signs, and ANSI Z535.4, Product Safety Signs and Labels, issued by the American National Standards Institute.

⚠ **DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ **WARNING** indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ **CAUTION** indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

⚠ **IMPORTANT** indicates an *emphasized* note. It is something you should be particularly aware of; something not readily apparent.

DEFINITION OF SYMBOLS

⚠ This symbol complies with IEC 601.1, and is described in IEC publication 348. The symbol prescribes the following information to the equipment user: **ATTENTION, CONSULT ACCOMPANYING DOCUMENTS.**

This symbol complies with IEC 601.1, and is described in IEC publication 878-02-03. The symbol prescribes the following information to the equipment user: **TYPE BF EQUIPMENT.***

This symbol complies with IEC 601.1, and is described in IEC publication 878-02-04. The symbol prescribes the following information to the equipment user: **DEFIBRILLATOR PROOF TYPE BF EQUIPMENT.***

This symbol complies with IEC 601.1, and is described in IEC publication 417-5032. The symbol prescribes the following information to the equipment user: **ALTERNATING CURRENT.**

This symbol complies with IEC 601.1, and is described in IEC publication 417-5016. The symbol prescribes the following information to the equipment user: **FUSE BOX.***

IPX1 This symbol complies with IEC 601.1, and is described in IEC publication 529. The symbol prescribes the following information to the equipment user: **PROTECTED AGAINST DRIPPING WATER.**

This symbol complies with IEC 601.1, and is described in IEC publication 417-5021. The symbol prescribes the following information to the equipment user: **EQUIPOTENTIALITY.**

GENERAL USE

⚠ **DANGER:** This equipment is not designed for use in an explosive atmosphere, in the presence of flammable anesthetics, or inside an oxygen tent. Use under these conditions may present an explosion hazard.

Read this manual before operating the Model 510/511 monitor. Keep this manual available for future reference and for the orientation of new personnel.

⚠ **WARNING:** Measurements may be affected in the presence of strong electromagnetic sources such as electrosurgical equipment.

The equipment should be kept clean, dry and free of transducer gels and other substances.

⚠ **WARNING:** Do not simultaneously connect more than one device that uses electrodes to detect ECG and/or respiration to the same patient. Use of more than one device in this manner may cause improper operation of one or more of the devices.

---

* *This symbol is shown on the Model 510/511 Monitor and/or its accessories manufactured for the United Kingdom. This symbol does not appear on units manufactured for the United States. For simplicity in the manual, all illustrations show the UK symbols.*

Do not operate the unit if any component is damp or wet due to condensation or spills. Avoid moving the equipment from a cold environment to a warm humid location. If the equipment is brought inside from outdoors, and is cold to the touch or below room temperature, allow the unit to stabilize at room temperature before operating.

Use only Corometrics protected patient cable, protected leadwires, and transducers with the monitor. If a patient cable, leadwire, power cord, or power plug is cracked, frayed, broken, or damaged in any way, it should be replaced immediately. Do not remove equipment covers. All repairs should be made by personnel authorized by Corometrics Medical Systems.

⚠ **WARNING:** Unprotected patient cables and electrode leads should ***not*** be used with the Model 510/511. Use only cables and lead pins with a protective design that ***prevents*** connection directly to electrical sources. If unprotected patient cables and electrode leads are used, there is a risk of inappropriate electrical connection which may cause patient shock or death.

Like all electronic monitoring devices, internal and external components are subject to fatigue, wear, and the potential for failure over time and under varying conditions of use. Additionally, events such as dropping the monitor, spilling liquids on the monitor or crimping the leadwires or patient cable may cause damage which could affect the performance of the monitor.

NOTE: The more detailed Recommended Maintenance Schedule and Functional Checkout Procedure should be performed prior to initial use and at least every six months thereafter. The Recommended Maintenance Schedule and Functional Checkout Procedure is detailed in Section 5, *Calibration*.

To ensure the continued safety and performance of the Model 510/511 monitor, it is recommended that the calibration, accuracy, and electrical safety of the monitor be verified on an annual basis by a Corometrics Service Representative.

Do not, under any circumstances, perform any testing or maintenance on the monitor while the unit is being used to monitor a patient.

This equipment contains components which may be destroyed or damaged by electrostatic discharge. Always use appropriate anti-static precautions when servicing this monitor. Such precautions include use of the following:

- grounded soldering irons
- anti-static solder removers
- grounded wrist straps
- grounded floor and bench mats
- conductive storage containers for PC boards and components

Per IEC 601.1, the Model 510/511 is **Class I** and can be used in continuous operation.

SAFETY PRECAUTIONS

Domestic (U.S.A.) equipment models are equipped with a hospital grade three-wire power plug and are designed to operate from a standard 120 VAC electrical outlet at 50/60 Hz. Equipment models manufactured for the United Kingdom are equipped with a standard UK fused three-wire power plug and are designed to operate from a standard 240 VAC electrical outlet at 50/60 Hz. Corometrics recommends the use of dedicated AC power lines. The equipment can be modified to operate from any of the following AC sources: 100, 120, 220, or 240 volts at 50 or 60 Hz; however, only those personnel designated by Corometrics Medical Systems, Inc. are authorized to make such modifications.

⚠ **WARNING:** Do not defeat the three-wire grounding feature of the power cord by means of adaptors, plug modifications, or other methods. A dangerous shock hazard to both patient and operator may result.

⚠ **WARNING:** During defibrillation, all personnel must avoid contact with the patient and monitor to avoid a dangerous shock hazard.

LEAKAGE CURRENT

Corometrics Model 510/511 Monitor is designed to comply with Underwriters Laboratory (UL 544), CSA, IEC, and TUV standards for leakage current in patient connected medical equipment. The system's inputs are electrically isolated as follows: SpO_2 is Type BF and ECG/RESP is Defibrillator Proof Type BF. Leakage current is limited to a few microamperes even when full power line voltage is applied. However, for maximum patient safety, a leakage test should be conducted following any repair or servicing of the equipment. When conducting a leakage test, conform to the UL 544 standards or similar ones such as the AAMI Safe Current Limits Standard on Leakage Current. If the monitor is connected to other equipment, leakage current should be rechecked to assure patient safety. However, for maximum patient safety, a leakage test should be conducted following any repairs, servicing, or periodic maintenance of the equipment.

INTRODUCTION

MONITORING METHODS

The Corometrics Model 510/511 with SpO_2 is capable of monitoring heart rate, respiratory rate, and SpO_2. The Model 510/511 also detects central apnea.

On the Model 511 all values, with the exception of central apnea, are displayed on the front panel of the monitor. A flashing heart symbol, displayed in the HEART RATE area, depicts each detected heartbeat and a flashing lung symbol, displayed in the RESPIRATION area, depicts each detected breath.

On the Model 510 a flashing heart symbol is displayed in the HEART RATE area to depict each detected heartbeat, a flashing lung symbol is displayed in the RESPIRATION AREA to depict each detected breath, and a solid O.K. label is displayed in the % SpO_2 area to indicate that the oxygen saturation level (% SpO_2) is being monitored.

The Model 510/511 is capable of monitoring patient parameters using the following clinical methods:

Heart Rate

Electrodes placed on either side of the patient's chest detect the signal caused by electrical changes produced by the heart. The heart rate is computed on a beat-to-beat basis using the time interval between R-R peaks.

Respiratory Rate

Electrodes placed on either side of the patient's chest use the transthoracic electrical impedance technique to obtain electrical signals from which calculated breathing rates and respiratory waveforms are derived.

Central Apnea

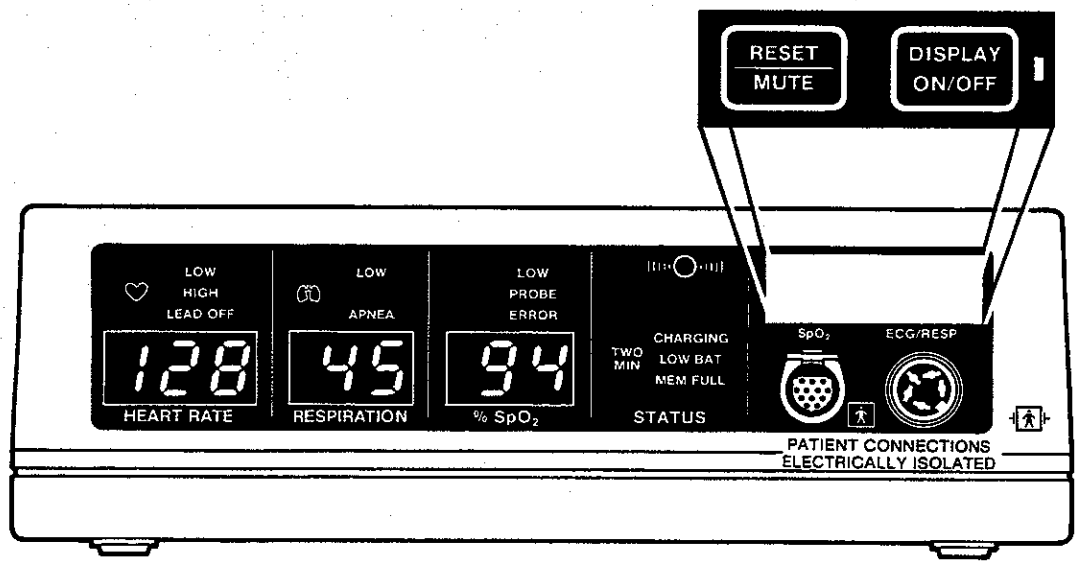
Central apnea is directly related to respiration. Central apnea is detected when a breath does not occur within the predefined time delay.

Pulse Oximetry

A sensor applied to a patient's extremity uses the principles of spectrophotometry and plethysmography to measure the absorption of selected wavelengths of light to determine the functional hemoglobin that is saturated with oxygen.

CONTROLS, INDICATORS, AND CONNECTORS

NOTE: For simplicity in the manual, all illustrations will depict the Model 511 Monitor except where noted.



FRONT PANEL CONTROLS

Display On/Off (Model 510)

The DISPLAY ON/OFF pushbutton is located on the upper right corner of the unit's front panel. The Model 510 is equipped with a child proof (sibling protection) ON/OFF mechanism. Press the DISPLAY ON/OFF pushbutton to turn on the monitor and illuminate the green power indicator to the right of the power pushbutton. To turn off the Model 510 press and hold the RESET pushbutton. After three seconds, while continuing to hold the RESET pushbutton, press and release the DISPLAY ON/OFF pushbutton. When the monitor turns off the green power indicator will extinguish and the RESET pushbutton may be released.

Display On/Off (Model 511)

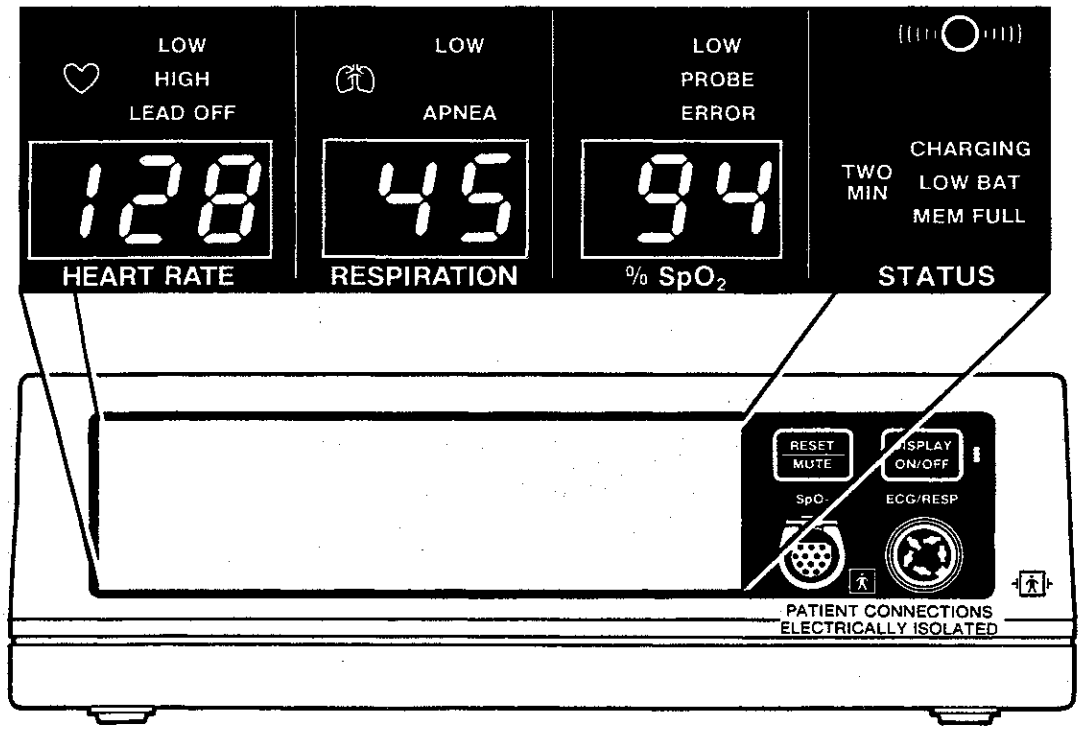
The DISPLAY ON/OFF pushbutton is located on the upper right corner of the unit's front panel. Press the DISPLAY ON/OFF pushbutton to turn on the monitor and illuminate the green power indicator to the right of the power pushbutton. Pressing the pushbutton again, turns off the Model 511 monitor and extinguishes the green indicator lamp.

Reset (Model 510)

The RESET pushbutton is a multi-functional pushbutton used to reset and mute (temporarily and permanently) certain visual and audio indicators and alarms.

Reset/Mute (Model 511)

The RESET/MUTE pushbutton is a multi-functional pushbutton used to reset and mute (temporarily and permanently) certain visual and audio indicators and alarms.



FRONT PANEL DISPLAY AND INDICATORS

Display On/Off

The green power indicator lamp to the right of the DISPLAY ON/OFF pushbutton will illuminate when the Model 510/511 monitor is turned on and ready to be used. When the monitor is turned off the green power indicator will extinguish.

Heart Rate Area (Model 510)

Low

The red LOW indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's average heart rate falls below the user selected low heart rate alarm limit.* When the patient's heart rate returns to a level equal to or above the alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

High

The red HIGH indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's heart rate exceeds the user selected high heart rate alarm limit.* When the patient's heart rate returns to a level equal to or below the alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

Lead Off

The yellow LEAD OFF indicator will flash and be accompanied by a constant alarm tone if the monitor's connection to the patient is broken for any reason while the monitor is on. Pressing the RESET pushbutton will disengage the audible alarm for 30 seconds. Once the connection is re-established, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

Heart Symbol

The green heart symbol flashes every time a heartbeat is detected.

** To set alarm limits refer to Section 4, Setup Procedures.*

Heart Rate Area (Model 511)

Low

The red LOW indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's average heart rate falls below the user selected low heart rate alarm limit.* Press the RESET/MUTE pushbutton for at least three seconds to temporarily (two minutes) disengage the audible alarm. When the patient's heart rate returns to a level equal to or above the alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

High

The red HIGH indicator will flash and be accompanied by an audible alarm of two beeps every second if the patient's heart rate exceeds the user selected high heart rate alarm limit.* Press the RESET/MUTE pushbutton for at least three seconds to temporarily (two minutes) disengage the audible alarm. When the patient's heart rate returns to a level equal to or below the alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

Lead Off

The yellow LEAD OFF indicator will flash and be accompanied by a constant alarm tone if the monitor's connection to the patient is broken for any reason while the monitor is on. Pressing the RESET/MUTE pushbutton will disengage the audible alarm for 30 seconds. To disengage the audible alarm for 2 minutes press and hold the RESET/MUTE pushbutton for at least three seconds. Once the connection is re-established, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

Heart Symbol

The green heart symbol flashes every time a heartbeat is detected.

Heart Rate Numeric

The three digit heart rate display continuously shows the average heart rate of the patient. If the heart rate goes outside of the alarm limit settings, the heart rate display will flash along with the alarm indicator (LOW or HIGH), and the audible alarm will sound. When the heart rate returns to within the set parameters, the audible alarm will cease and the heart rate display and the alarm indicator will stop flashing; but the indicator will remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish the alarm indicator.

The heart rate display shows flashing dashes (- - -) when the LEAD OFF equipment alarm occurs. The dashes (- - -) will be replaced by the heart rate numeric when the alarm is resolved.

Respiration Area (Model 510)

Low

The red LOW indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's average respiratory rate falls below the user selected low respiration rate alarm limit.* When the patient's respiratory rate returns to a level equal to or above the alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

Apnea

The red APNEA indicator will flash and be accompanied by an audible alarm of one beep every second if breathing is not detected for longer than the user selected apnea alarm limit.* When breathing resumes, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

Lung Symbol

The green lung symbol flashes every time a breath is detected.

Respiration Area (Model 511)

Low

The red LOW indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's average respiratory rate falls below the user selected low

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* *To set alarm limits refer to Section 4, Setup Procedures.*

respiration rate alarm limit.* Press the RESET/MUTE pushbutton for at least three seconds to temporarily (two minutes) disengage the audible alarm. When the patient's respiratory rate returns to a level equal to or above the alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

Apnea

The red APNEA indicator will flash and be accompanied by an audible alarm of one beep every second if breathing is not detected for longer than the user selected apnea alarm limit.* Press the RESET/MUTE pushbutton for at least three seconds to temporarily (two minutes) disengage the audible alarm. When breathing resumes, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

Lung Symbol

The green lung symbol flashes every time a breath is detected.

Respiration Rate Numeric

The three digit respiration display continuously shows the average respiratory rate of the patient. If the respiration rate goes outside of the alarm limit settings, the respiratory rate display will flash along with the alarm indicator (LOW or APNEA), and the audible alarm will sound. When the respiratory rate returns to within the set parameters, the audible alarm will cease and the respiratory rate display and the alarm indicator will stop flashing; but the indicator will remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish the alarm indicator.

The respiration rate display shows flashing dashes (- - -) when the LEAD OFF equipment alarm occurs. The dashes (- - -) will be replaced by the respiration rate numeric when the alarm is resolved.

% SpO_2 Area (Model 510)

NOTE: When SpO_2 is not being monitored, the % SpO_2 area is blank.

Low

The red LOW indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's average SpO_2 falls below the user selected low SpO_2 alarm limit.* When the patient's SpO_2 level rises equal to or above the low SpO_2 alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

Probe

The yellow PROBE indicator will flash and be accompanied by a constant audible alarm if the probe is disconnected for any reason from the monitor; or the SpO_2 signal strength is insufficient and can not be detected. Pressing the RESET pushbutton will disengage the audible alarm for 30 seconds. Once all connections are connected properly and/or the sensor has been moved to a site with a sufficient SpO_2 signal strength, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

Error

The yellow ERROR indicator will flash and be accompanied by a constant audible alarm if the oximetry option is not available due to an electronic failure. Once the electronic failure has been remedied the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET pushbutton to extinguish this indicator.

O.K. Label

A green O.K. label is steadily displayed when a valid SpO_2 reading is detected.

% SpO_2 Area (Model 511)

NOTE: When SpO_2 is not being monitored, the % SpO_2 area is blank.

Low

The red LOW indicator will flash and be accompanied by an audible alarm of one beep every second if the patient's average SpO_2 falls below the user selected low SpO_2 alarm limit.* Press the RESET/MUTE pushbutton for at least three seconds to temporarily (two minutes) disengage the audible alarm. When the patient's SpO_2 level rises equal to or above the low SpO_2 alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated,

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* *To set alarm limits refer to Section 4, Setup Procedures.*

indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

Probe

The yellow PROBE indicator will flash and be accompanied by a constant audible alarm if the probe is disconnected for any reason from the monitor; or the SpO_2 signal strength is insufficient and can not be detected. Press the RESET/MUTE pushbutton for at least three seconds to temporarily (two minutes) disengage the audible alarm. Once all connections are connected properly and/or the sensor has been moved to a site with a sufficient SpO_2 signal strength, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/ MUTE pushbutton to extinguish this indicator.

Error

The yellow ERROR indicator will flash and be accompanied by a constant audible alarm if the oximetry option is not available due to an electronic failure. Once the electronic failure has been remedied the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

% SpO_2 Numeric

The three digit % SpO_2 display continuously shows the oxygen saturation level of the patient. If the level falls below the alarm limit setting, the % SpO_2 display will flash along with the LOW alarm indicator, and the audible alarm will sound. When the SpO_2 level rises equal to or above the LOW alarm limit, the audible alarm will cease and the indicator will stop flashing, but remain illuminated, indicating an alarm occurred. Press the RESET/MUTE pushbutton to extinguish this indicator.

When an SpO_2 equipment alarm (PROBE or ERROR) occurs, the % SpO_2 display will show flashing dashes (- -). The dashes (- -) will be replaced by the % SpO_2 numeric when the alarm is resolved.

Status Area (Model 510)

Charging

The green CHARGING indicator will be illuminated whenever the internal battery is being charged. The battery will be charged whenever the monitor is connected to an external power source through the AC power source/charger connector located on the rear panel. To ensure the internal battery will be fully charged when needed it is recommended that the monitor be connected to an external power source (charging) even when not in use.

> **NOTE:** When charging the Model 510 the monitor does not have to be on. Thus, when the monitor is off, the only indicator that may be illuminated is the green CHARGING indicator.

Low Bat

The LOW BAT indicator is only applicable to monitors operating from the internal battery. The yellow LOW BAT indicator will flash and be accompanied by an audible alarm of 3 beeps every 30 seconds when the internal battery will support only 30 more minutes of operation for the Model 510 with SpO_2 (60 minutes for the Model 510 without SpO_2). Press the RESET pushbutton to temporarily (30 seconds) disengage the audible alarm. To end this alarm condition, thus silencing the audible alarm and extinguishing the flashing indicator, turn the monitor off or plug the monitor into an external power source through its AC power source/ charger connector located on the rear panel. By doing this the battery is being charged (the CHARGING indicator will illuminate) and power is being supplied to the Model 510, so monitoring may continue.

> **NOTE:** The monitor should be plugged into an AC power source as soon as the LOW BAT alarm is heard.

Mem Full

> **NOTE:** The internal compliance log memory collects compliance data. The retrieval of this data will be available in the near future.

The yellow MEM FULL indicator will flash and be accompanied by an audible alarm of 1 beep every 10 seconds when the internal compliance log memory is 80% full. Press the RESET pushbutton to permanently silence the audio alarm; the flashing indicator will remain on.

When the internal memory is 100% full, the MEM FULL indicator will constantly illuminate (solid, not flashing). Pressing the RESET pushbutton will not turn off this alarm indicator. To turn the MEM FULL indicator off, clear the memory. (Refer to Section 4, *Setup Procedure*, for more information regarding clearing the memory.)

Status Area (Model 511)

Two Min

The yellow TWO MIN indicator will be illuminated when the user has disabled the alarm audio output for a patient alarm. To silence a patient audio alarm for two minutes, press and hold the RESET/MUTE pushbutton, for at least three seconds, until the yellow TWO MIN indicator is illuminated. The indicator turns off when the alarm audio is re-enabled. This will occur automatically after two minutes or when the user re-enables it manually by pressing the RESET/MUTE pushbutton again.

Charging

The green CHARGING indicator will be illuminated whenever the internal battery is being charged. The battery will be charged whenever the monitor is connected to an external power source through the AC power source/charger connector located on the rear panel. To ensure the internal battery will be fully charged when needed it is recommended that the monitor be connected to an external power source (charging) even when not in use.

> **NOTE:** When charging the Model 511 the monitor does not have to be on. Thus, when the monitor is off, the only indicator that may be illuminated is the green CHARGING indicator.

Low Bat

The LOW BAT indicator is only applicable to monitors operating from the internal battery. The yellow LOW BAT indicator will flash and be accompanied by an audible alarm of 3 beeps every 30 seconds when the internal battery of the Model 511 with and without SpO_2 will support only 30 more minutes of operation. Press the RESET/MUTE pushbutton for at least 3 seconds to temporarily (2 minutes) disengage the audible alarm. To end this alarm condition, thus silencing the audible alarm and extinguishing the flashing indicator, turn the monitor off or plug the monitor into an external power source through its AC power source/charger connector located on the rear panel. By doing this the battery is being charged (the CHARGING indicator will illuminate) and power is being supplied to the Model 511, so monitoring may continue.

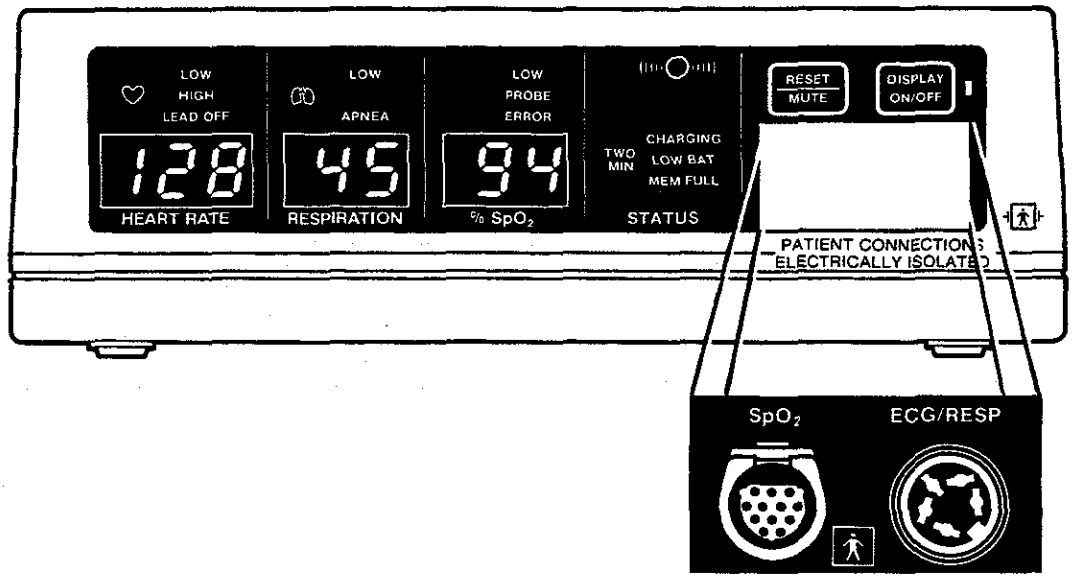
> **NOTE:** The monitor should be plugged into an AC power source as soon as the LOW BAT alarm is heard.

Mem Full

> **NOTE:** The internal compliance log memory collects compliance data. The retrieval of this data will be available in the near future.

The yellow MEM FULL indicator will flash and be accompanied by an audible alarm of 1 beep every 10 seconds when the internal compliance log memory is 80% full. Press the RESET/MUTE pushbutton to permanently silence the audio alarm; the flashing indicator will remain on.

When the internal memory is 100% full, the MEM FULL indicator will constantly illuminate (solid, not flashing). Pressing the RESET/MUTE pushbutton will not turn off this alarm indicator. To turn the MEM FULL indicator off, clear the memory. (Refer to Section 4, *Setup Procedure*, for more information regarding clearing the memory.)



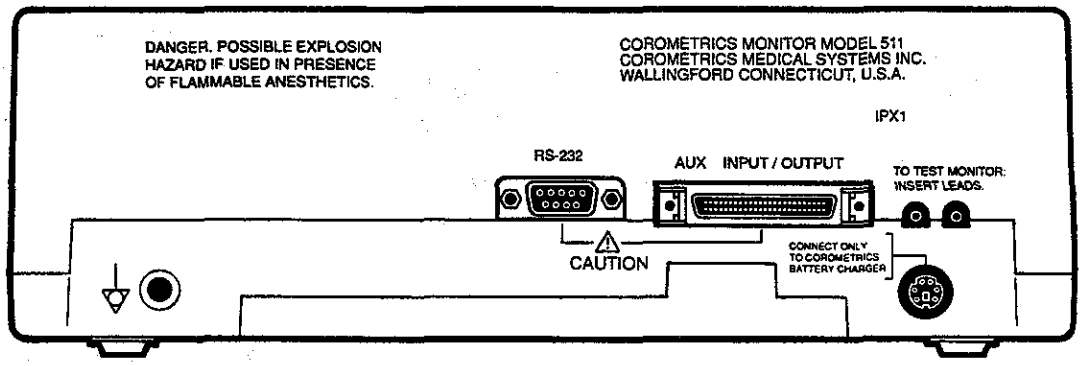
FRONT PANEL CONNECTORS

ECG/Resp

The ECG/RESP connector is a 5-pin DIN connector mechanically keyed to accept Corometrics Model 510/511, or compatible, ECG/RESP patient cables.

SpO_2

The SpO_2 connector is a 10-pin Hypertronics type connector mechanically keyed to accept only Nellcor sensor interface cables.



REAR PANEL CONNECTORS

AC Power Source/Charger (Power Cord)

The AC POWER SOURCE/CHARGER connector is a 6-pin miniature circular DIN connector used when charging the internal battery of the Model 510/511 or simultaneously, powering the monitor through an AC power source.

Equipotential Lug ⏚

Binding post terminal directly connected to chassis for use as an equipotentiality connection.

Monitor Test Connectors

The monitor test connectors are two test jacks used when conducting a self-test on the monitor, patient cable and leadwires.

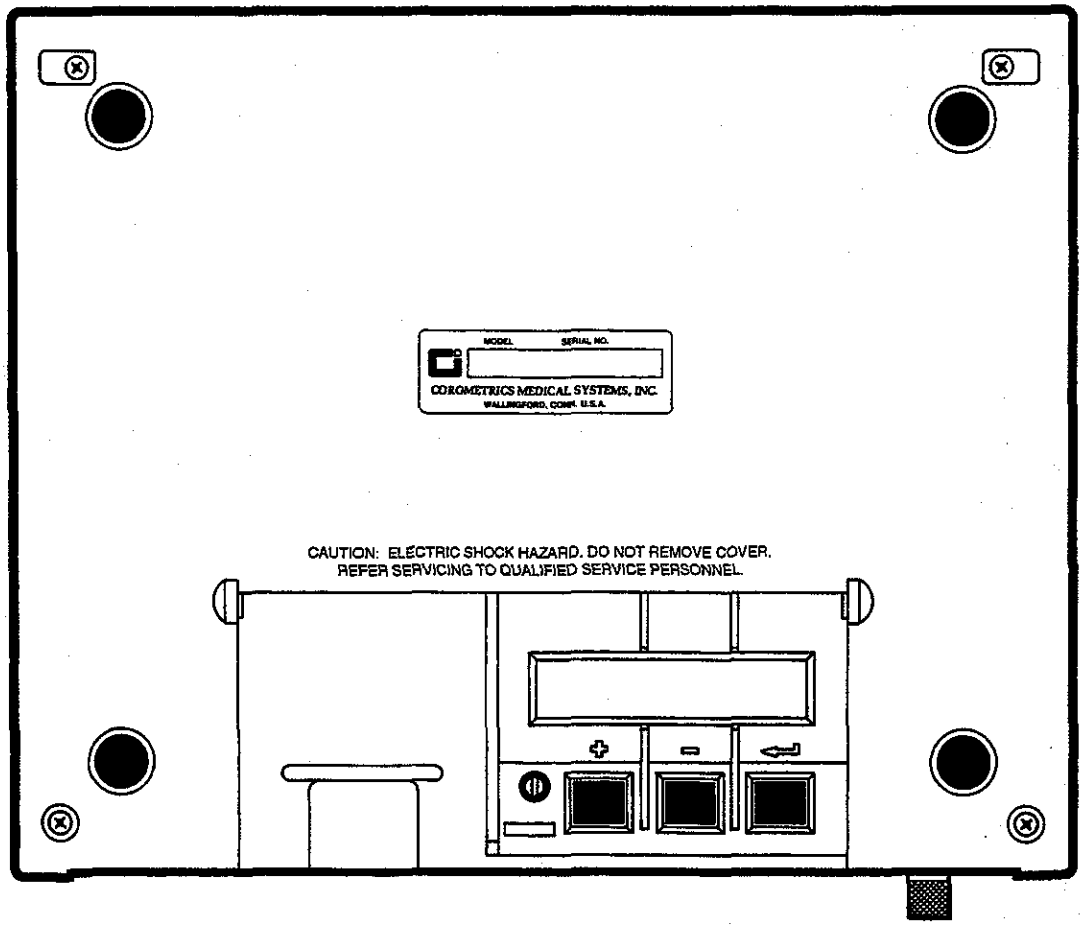
Aux. Input/Output

The AUX. INPUT/OUTPUT connector is a high density, 50-pin Amplimite .050 series connector used to connect compatible external recording devices, external oximeters, nasal thermistors, or any other analog signal input to the Model 510/511.

RS-232

The RS-232 connector is a 9-pin miniature "D" shell serial connector. This connector is available for a modem or computer hookup, and for future optional external devices.

NOTE: Retrieval of data via modem or computer hookup will be available in the near future.


MODEL
SERIAL NO.
COROMETRICS MEDICAL SYSTEMS, INC.
WALLINGFORD, CONN. U.S.A.
CAUTION: ELECTRIC SHOCK HAZARD. DO NOT REMOVE COVER.
REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

CONFIGURATION MENU CONTROLS

LCD Access Door

Most of the user changeable settings which control the operation of the Model 510/511 are viewed and changed through the use of an LCD screen and three pushbuttons located behind a hinged door on the bottom of the monitor.

To open the LCD access door, turn the monitor upside down, with the rear panel connectors facing you. Insert a flat-bladed screwdriver in the slot located on the hinged door. With one hand, pull the screwdriver's handle toward the rear panel of the monitor to release the small internal hook that keeps the door closed. With the other hand, push up on the edge of the door from the rear panel. If the internal hook has been released, the door will open.

LCD Control Panel

NOTE: Power must be on to view the LCD control panel.

The pushbuttons +, –, and ↵ are used to enter and exit the configuration menus that are provided to tailor the unit for varying clinical applications.

The ALARM LIMITS configuration menu allows the user to:

- set the apnea limit;
- set the low heart rate limit;
- set the high heart rate limit;
- set the low respiratory rate limit; and
- set the low SpO_2 limit.

The SETUP MENU allows the user to:

- adjust the alarm volume;
- adjust the QRS volume (Model 510 only);
- test the front LCD control panel lights;
- adjust the computer or modem baud rate;
- select the appropriate patient mode;
- select the averaging mode for SpO_2 response time;
- turn ECG synchronization on or off;
- clear memory (access to memory data will be available in the near future); and
- set the month, day, year, hour, and minute.

The OTHER configuration menu allows the user to:

- set menu items back to their defaults;
- select the appropriate AC line frequency; and
- select the appropriate language.

Input Pushbuttons

Three pushbuttons are used to enter all information into the monitor.

+ Pushbutton

The + pushbutton is used to:

- enter passwords;
- enter menus;
- indicate a "yes" response to a yes or no question;
- increment displayed numeric values;
- toggle forward in a list; and
- confirm new selections.

– Pushbutton

The – pushbutton is used to:

- enter passwords;
- indicate a "no" response to a yes or no question;
- decrease displayed numeric values; and
- toggle backwards in a list.

↵ Pushbutton

This ↵ pushbutton is used to:

- advance to the next configuration menu;
- advance to the next item in a menu;
- toggle through selections in a menu;
- store newly selected values; and
- confirm passwords.

SETUP PROCEDURES

POWER AND SELF-TEST ROUTINES

The self-test is the best way to quickly determine if the Model 510/511 monitor and its accessories are functioning properly. Each time the Model 510/511 is turned on a simple monitor self-test routine is automatically initiated. This self-test routine checks the integrity of the internal circuitry of the monitor.

The routine maintenance check is a visual inspection performed by the user. The routine maintenance check consists of inspecting the monitor, patient cable, leadwires and other accessories for cracks and signs of wear or damage.

> **NOTE:** It is recommended practice to initiate a routine maintenance check and the ***full*** self-test feature on a daily basis and when the patient cable and leadwires are changed. The full self-test feature includes testing the patient cable and leadwires which are not automatically tested each time the monitor is turned on. Do not use any equipment that is worn or damaged.

Full Self-Test Procedure

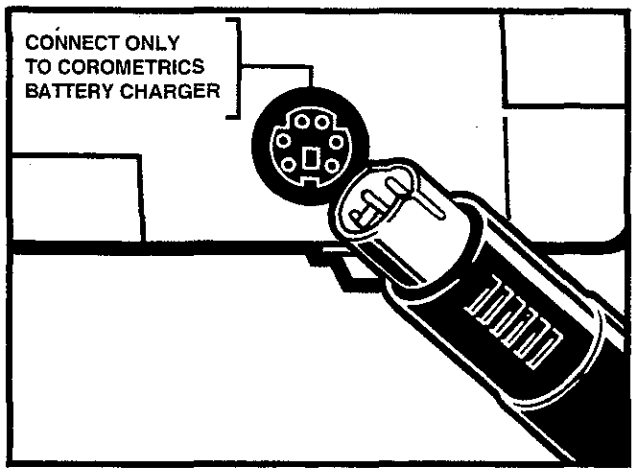
1. Ensure the power is *off*.

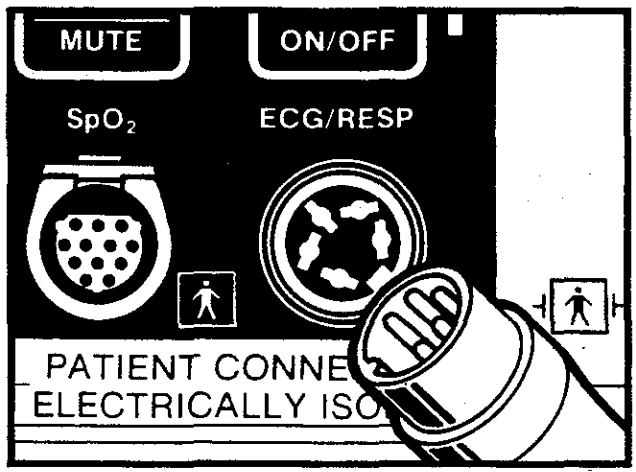
2. With the arrow facing up, connect the round end of the AC power source/charger to the rear panel AC power source/charger connector; plug the other end into a hospital grade grounded wall outlet of appropriate voltage. When the monitor is connected to an AC power source the green CHARGING indicator will be illuminated.

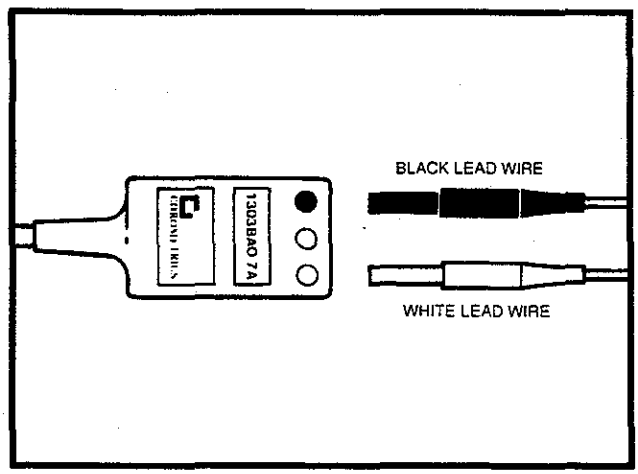
   NOTE: The self-test may also be conducted when running the monitor from the internal battery.

3. Connect the round end of the patient cable to the ECG/RESP port on the front of the monitor. To do this, align the small notch in the plastic end of the connector with the tab in the front panel port.

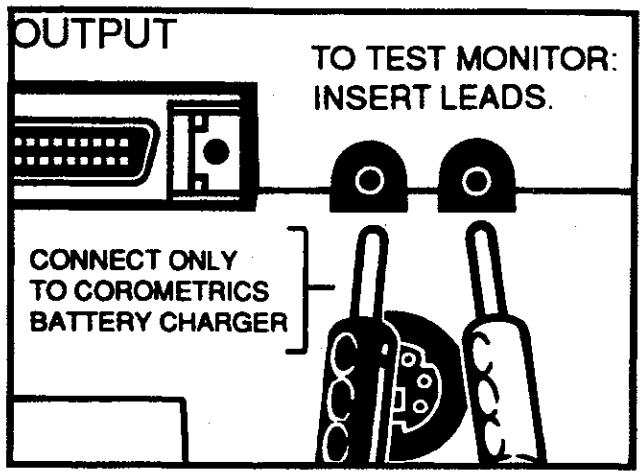
4. Insert the female ends of the black and white leadwires into the flat, recessed male end of the patient cable. The white leadwire should be plugged in under the white dot and the black leadwire under the black dot.





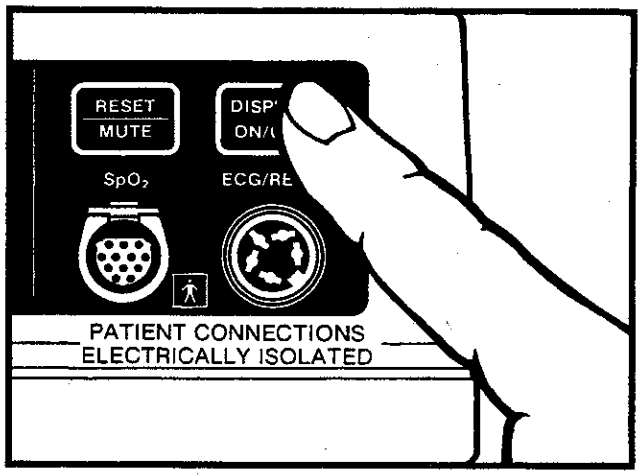


5. Plug the male ends of the leadwires into the Monitor Test Connectors in any order.



6. Turn on the monitor by pressing the DISPLAY ON/OFF pushbutton. When the power is first turned ***on***, a tone is emitted and the green power indicator is illuminated.

7. The monitor self-test will perform the following:



For the Model 510—

- A three second alarm sound check.
- The indicators, heart and lung symbols, and O.K. label will illuminate for 30 seconds.
- Next, four beeps sound as all indicators clear except for the flashing heart and lung symbols. The flashing heart represents the detection of a self-test generated heartbeat and the flashing lung symbol represents the detection of a self-test generated breath.
- The monitor will then alternate between the self-test generated heart and lung symbols and the self-test of the indicators and O.K. label. An alarm beep will accompany the self-test of the indicators and O.K. label.

NOTE: When the monitor is connected to an AC power source the green CHARGING indicator will be illuminated at all times. If the self-test is performed while the monitor is running off the battery, the green CHARGING indicator will not be illuminated at any time.

For the Model 511—

- A three second alarm sound check.
- The indicators, numeric displays, and the heart and lung symbols will illuminate for 30 seconds. The numerics will then run through a series of tests and become stable.
- Next, four beeps sound as all indicators clear except for the self-test generated heart rate and respiratory rate and the flashing heart and lung symbols. The flashing heart symbol represents the detection of a self-test generated heartbeat and the flashing lung symbol represents the detection of a self-test generated breath. The generated heart rate is 128 ± 2 beats per minute and the generated respiratory rate is 60 ± 2 breaths per minute.
- The monitor will then alternate between the self-test generated heart rate and respiratory rate (including the heart and lung symbols) and the self-test of the indicators and numerics (minus the heart and lung symbols). An alarm beep will accompany the self-test of the indicators and numerics.

NOTE: When the monitor is connected to an AC power source the green CHARGING indicator will be illuminated at all times. If the self-test is performed while the monitor is running off the battery, the green CHARGING indicator will not be illuminated at any time.

8. If the lights do not flash, the alarm does not sound, the generated heart rate is not 128 ± 2 beats per minute (Model 511 only), or the generated respiratory rate is not 60 ± 2 breaths per minute (Model 511 only) make sure that the leadwires and the patient cable are connected properly and repeat the entire test.

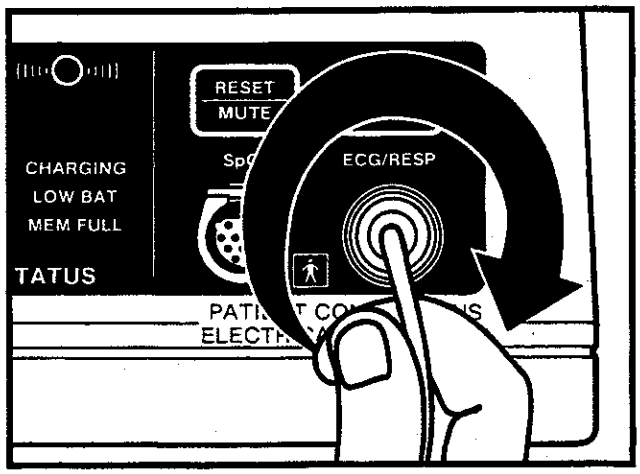
   NOTE: If the self-test of the monitor seems to fail randomly, ensure that the problem is not electromagnetic interference by moving the monitor to a different site in the room away from any other electrical equipment or appliances.

⚠ **WARNING:** If the self-test continues to fail, ***do not use the monitor***. Contact your Corometrics Service Representative for help.

9. When the monitor has passed the self-test, check for susceptibility in the actual-use environment by keeping the monitor in the self-test mode and moving it around in a wide, 360° circle. If the monitor fails anywhere along this route the problem may be electromagnetic interference. Ensure the monitor is placed outside of the area where electromagnetic interference will disturb the monitoring process.

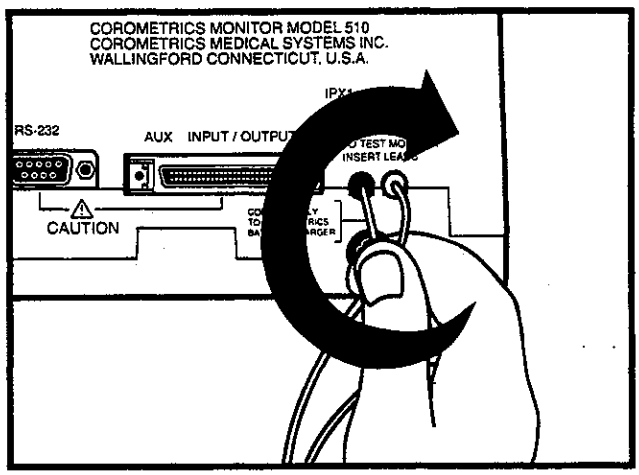
Testing the Patient Cable and Leadwires

To test the patient cable and leadwires, wait until the monitor has completed the monitor self-test and is cycling between the self-test generated heart rate and respiratory rate (including the heart and lung symbols) and the self-test of the indicators and numerics (minus the heart and lung symbols) for the Model 511 or cycling between the self-test of the heart and lung symbols and the self-test of the indicators and the O.K. label for the Model 510. While the lights are flashing, gently move the patient cable and each leadwire connector end in a circular motion. Test each of the five connections individually. The monitor should remain in self-test mode during this procedure indicating that the patient cable and leadwires are not damaged.

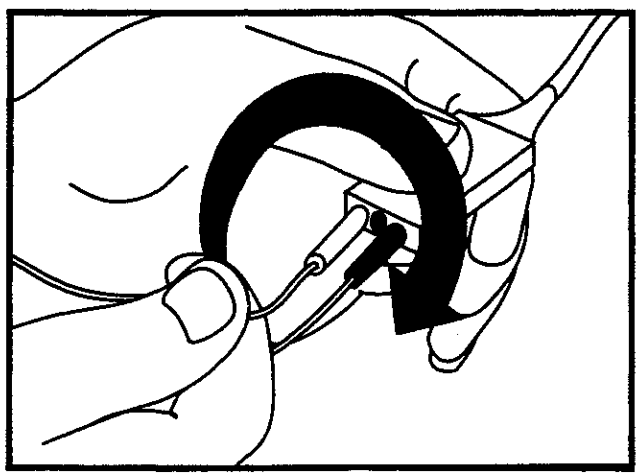


If the monitor exits the self-test mode, the yellow LEAD OFF indicator will illuminate and be accompanied by an alarm sound. Replace the patient cable with a new one and repeat the test. If the monitor exits the self-test mode again, replace both leadwires and repeat the test a second time.

⚠ **WARNING:** If the yellow LEAD OFF indicator remains illuminated and the alarm is still sounding, ***do not use the monitor***. Contact your Corometrics Service Representative for help. Do not use any patient cable or leadwire that fails this test.



If the monitor, cables, leadwires, and generated heart and respiratory rates (Model 511 only) pass the self-test, unplug the leadwires from the back of the monitor and turn off the monitor. The monitor, patient cable and leadwires are working as they should.



LCD CONTROL PANEL – CONFIGURATION MENUS

Three configuration menus, ALARM LIMITS, SETUP MENU, and OTHER, provide the ability to tailor the Model 510/511 for varying clinical applications. To access a configuration menu and to alter a menu item's setting proceed as follows:

1. Turn on the monitor by pressing the DISPLAY ON/OFF pushbutton.

2. Turn the monitor over and open the LCD access door as described in Section 3.

3. The LCD status screen will display one of three status message/warnings. They are:

   - **VERSION X.XX**
     PRESS ANY KEY — This message indicates the software version number. When the software is updated the version number displayed will be updated.

   - **MEMORY 100% FULL**
     PRESS ANY KEY — This message indicates the internal compliance log memory is 100% full.

   - **MEMORY 80% FULL**
     PRESS ANY KEY — This message indicates the internal compliance log memory is 80% full.

   NOTE: The retrieval of data stored in memory will be available in the near future.

4. Press any key, after reading the status message/warning, to advance to the first configuration menu.

5. Press the ↵ pushbutton to move between the three configuration menus. Successively press this pushbutton until the configuration menu to be accessed is shown.

6. To gain access to the menu items of any configuration menu, press the + pushbutton when the configuration menu is displayed.

7. To access the configuration menus of the Model 510 a password is required. The Model 511 only requires a password for the OTHER configuration menu. When **ENTER PASSWORD** is displayed enter:

   - + + – + ↵ to access the ALARM LIMITS configuration menu (Model 510 only).

   - – + – – ↵ to access the SETUP MENU configuration menu (Model 510 only).

   - – – – + ↵ to access the OTHER configuration menu.

   If the password is incorrect **INVALID PASSWORD** will be displayed. Pressing the +, –, or ↵ pushbutton will return the user to the original configuration menu.

8. To store a value or to cycle through a menu use the ↵ pushbutton.

9. Most menu items can be altered by successively pressing the + pushbutton to increment or the – pushbutton to decrement through the available choices. The sequential order always begins at the previously set value; as the + and – pushbuttons are pressed the values will increase or decrease respectively and will continue to wrap around. For example, an incrementing order might be 10, 15, 20, 25, 30, 10..., etc.

   Some menu items allow the user a choice to perform a certain function. Pressing the required pushbutton will activate this function.

10. When the ALARM LIMITS configuration menu is altered, confirmation of the altered selection is required. To start the confirmation process press the ↵ pushbutton. Press the + pushbutton to confirm the new value for that menu item and to proceed to the next menu item. If a mistake was made and the new value is not desired, pressing the – pushbutton or the ↵ pushbutton will bring the user back to the original menu item and value.

    When the SETUP MENU and the OTHER configuration menus are altered the confirmation process does not take place. Pressing the ↵ pushbutton stores the new value and continues to the next menu item.

    NOTE: Because of the allowable range of alarm limits, it is possible to overlap the low and high limit values for the heart rate alarm. If this happens the limit that will cause an overlap will not be accepted. When the + pushbutton is pressed to confirm the selection, the message LIMITS OVERLAP PRESS ANY KEY will be displayed. This will return the user to the original menu item and value.

11. After one cycle of the menu a choice to REVIEW or EXIT the menu is displayed. Press the + pushbutton to review the menu or press the – pushbutton to exit the menu.

12. If the LCD is left idle in any screen for more than 60 seconds, the LCD will return to the status message/ warning screen automatically. Any changes already confirmed using the + pushbutton will be remembered. If a change is not yet confirmed, it will be lost and the original value will still be in effect.

Alarm Limits Configuration Menu

The ALARM LIMITS configuration menu allows the user to:

- set the apnea limit;
- set the low heart rate limit;
- set the high heart rate limit;
- set the low respiratory rate limit; and
- set the low SpO_2 limit.

Apnea

This setting establishes the period between onset of central apnea (cessation of breath), and the time the monitor activates the APNEA alarm. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings in seconds are: 5-30 in increments of 5. This alarm cannot be turned off. (The default setting is 20 seconds.)

Heart Rate Low

This setting establishes the low heart rate alarm limit based on the current average of detected R-R intervals. If the average heart rate, as displayed on the HEART RATE numeric display, falls below this value, a low heart rate alarm occurs. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings in beats per minute are: 40-100 in increments of 5. This alarm cannot be turned off and cannot be changed to a value equal to or higher than the HEART RATE HIGH limit setting. (The default setting is 80 BPM.)

Heart Rate High

This setting establishes the high heart rate alarm limit based on the current average of detected R-R intervals. If the average heart rate, as displayed on the HEART RATE numeric display, rises above this value, a high heart rate alarm occurs. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings in beats per minute are: OFF and 80-250 in increments of 5. This alarm can be turned off but cannot be changed to a value equal to or lower than the HEART RATE LOW limit setting. (The default setting is 200 BPM.)

Resp Rate Low

This setting establishes the low respiratory rate alarm limit based upon the frequency of detected respiration effort. If the average respiratory rate, as displayed on the RESPIRATION numeric display, falls below this value, a low respiratory rate alarm occurs. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings in breaths per minute are: OFF, 5-10 in increments of 1, 10-20 in increments of 2, and 20-30 in increments of 5. (The default setting is OFF.)

NOTE: This alarm operates independently of the apnea alarm.

SpO_2 Low

This setting establishes the alarm limit based on the percentage of functional hemoglobin that is saturated with oxygen. If the average SpO_2 as displayed on the SpO_2 numeric display, falls below this value, a low SpO_2 alarm occurs. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings measured as percent of oxygen saturation in the blood are: OFF, 70-85 in increments of 5, and 85-95 in increments of 1. (The default setting is 85 percent.)

Setup Menu

The SETUP MENU allows the user to:

- adjust the alarm volume;
- adjust the QRS volume (Model 511 only);
- test the front LCD control panel lights;
- adjust the modem baud rate;
- choose the appropriate patient mode;
- choose the averaging mode for SpO_2 response time;
- turn ECG synchronization on or off;
- clear memory; and
- set the month, day, year, hour, and minute.

Alarm Volume

This setting establishes the volume of the audio alarm tone. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings are: 3-5 with a setting of 3 producing the lowest volume, and a setting of 5 producing the highest volume for the Model 510. For the Model 511 the available settings are: 1-5 with a setting of 1 producing the lowest volume, and a setting of 5 producing the highest volume. This alarm cannot be turned off. (The default setting is 5.)

QRS Volume (Model 511 Only)

This setting establishes the volume of the QRS beep, which occurs each time the monitor detects a valid heartbeat. When SpO_2 is being monitored simultaneously, each heartbeat is indicated with a beep that varies in pitch to reflect changes in the oxygen saturation reading. The pitch rises as the saturation values increase; the pitch lowers as the saturation values decrease. Pressing the + or – pushbutton increments or decrements the selection choices. The available settings are: OFF, and 1-5. (The default setting is 5.)

Test Lights

This screen allows the user to test the front panel displays and indicators. To use this function a LOOSE LEAD condition must be occurring. Press the + pushbutton to illuminate all front panel displays and indicators. The front panel displays and indicators will return to normal operation when the – pushbutton is pressed; any displays and indicators that were on at the time of the test will remain on. Press the ↵ pushbutton to return to normal operation and advance to the next item in the menu.

> ***Exceptions***: The TEST LIGHTS option has no effect on the DISPLAY ON/OFF indicator which is always illuminated when the monitor is on. The CHARGE indicator is only controlled by the AC power source/ charger and therefore can not be tested with this screen. Plugging the monitor into an external power source will always light this indicator.

Computer or Modem Baud Rate

This screen allows the user to select the serial communication baud rate. Pressing the + or – pushbutton increments or decrements the selection choices. The selections are: 1200, 2400, 4800, or 9600 baud. (The default setting is 9600 baud.)

> **NOTE:** The computer or modem baud rate can be set at this time but will not have any significance until data can be retrieved from the internal compliance log memory. The retrieval of data stored in memory will be available in the near future.

Patient Mode

This screen allows the user to configure the monitor for monitoring either an infant patient or, for in the future, an adult patient. Currently the monitoring modes are NEONATE, for monitoring infant patients, and RESERVED, for future adult monitoring. If the patient mode is inadvertently set to RESERVED, it will automatically default to the NEONATE mode until the ADULT mode is available. Pressing the + and – pushbuttons will toggle the mode between NEONATE and RESERVED. (The default setting is NEONATE.)

> **NOTE:** Even though when placed in the RESERVED mode the monitor defaults to the NEONATE mode, it is recommended that the NEONATE mode be selected at all times until RESERVED mode is available for use.

SpO_2 Averaging

In order to compensate for different levels of patient activity, the user chooses the appropriate mode for SpO_2 averaging. Pressing the + or – pushbutton increments or decrements the selection choices. The available modes are SLOW, NORMAL, and FAST. Decrementing follows the reverse sequence. The SLOW mode of operation uses a 10- to 15-second averaging period and is least affected by patient movement; this mode should be selected if using ECG synchronization on active patients. The NORMAL mode of operation uses a 5- to 7-second averaging period and is recommended in cases where the patient is relatively inactive. The FAST mode of operation uses a 2- to 3-second averaging time and is most affected by patient movement. (The default setting is NORMAL.)

ECG Synchronization

To provide more reliable saturation measurements in a high-motion environment or when a patient has poor perfusion, an ECG trigger, marking the R-R interval signal, may be used as a time reference to identify pulse and synchronization saturation measurements. Use either the + or – pushbutton to turn ECG SYNCH on or off. (The default setting is OFF.)

Clear Memory

The CLEAR MEMORY screen is used to erase all information from the internal compliance log memory of the monitor. Press the + pushbutton to erase all previously stored data and to turn off the MEM FULL indicator.

> **NOTE:** The ability to retrieve data stored in the internal compliance log memory will be available in the near future.

Month, Day, Year, Hour, and Minute

The internal clock can be changed only *after* the CLEAR MEMORY function has been applied and the memory is clear. If memory is not clear, these screens will not appear.

These screens permit the user to change the monitor's internal clock. Use the + and – pushbuttons to increase or decrease the value for each of these screens until the correct date and time has been entered.

> **NOTE:** Until retrieval of data stored in memory is available in the near future, these screens have no significant use.

Other Configuration Menu

The OTHER MENU allows the user to:

- set menu items back to their defaults;
- select the appropriate AC line frequency; and
- select the desired language.

Set Defaults

This screen allows the user to set all menu items with defaults back to their original manufactured default settings (refer to Table 4-1 for range and default values). Press the + pushbutton to accomplish this. Press the – pushbutton or the ↵ pushbutton to continue on to the next item in the menu.

Line Frequency

Set the LINE FREQUENCY to the standard in your country. Use the – and + pushbuttons to toggle between 50 and 60 Hz. Press the ↵ pushbutton to store this value and continue on to the next item. (The default setting is 60 Hz.)

Language

This screen allows the user to choose what language the LCD panel configuration menus are displayed in. Press the ↵ pushbutton to store this value and continue on to the next item. Pressing the + and – pushbuttons will toggle the language mode between ENGLISH, FRANÇAIS, DEUTSCH, and ESPAÑOL. (The default setting is ENGLISH.)

BATTERY OPERATION

The Model 510/511 has a rechargeable internal battery which will power the monitor when an AC power source is not available. The monitor will automatically switch to battery operation when the AC power source fails or the AC power source/charger becomes disconnected while in use. The internal battery is being charged whenever the monitor is plugged into an AC power source.

To set up the monitor for battery operation, complete normal setup as described in this section, but do not attach the AC power source/charger; it will not be used during this operation. Make sure the internal battery is fully charged before taking the Model 510/511 off the AC power source.

Battery operating time should be limited to 24 hours or less for the Model 510 and 15 hours or less for the Model 511 without SpO_2, and 10.5 hours or less for the Model 510 and 7.5 hours or less for the Model 511 with SpO_2. Afterwards, the monitor should be connected to an AC power source for 8 continuous hours to recharge the battery to at least 90% capacity. Keep the battery fully charged for emergencies and portable monitor operation.

> **NOTE:** Do not operate the monitor on battery power unless it is necessary.

Table 4-1. Factory Default Settings.

MENU ITEM	RANGE	DEFAULT
Apnea (seconds)	5-30 in increments of 5	20
Heart Rate Low (beats per minute)	40-100 in increments of 5	80
Heart Rate High (beats per minute)	Off, and 80-250 in increments of 5	200
Resp Rate Low (breaths per minute)	Off, 5-10 in increments of 1, 10-20 in increments of 2, and 20-30 in increments of 5	Off
SpO_2 Low (percent)	Off, 70-85 in increments of 5, and 85-95 in increments of 1	85
Alarm Volume	3-5 (Model 510) 1-5 (Model 511)	5
QRS Volume	Off, and 1-5 (Model 511 only)	5
Computer or Modem Baud Rate* (character per second)	1200, 2400, 4800, and 9600 Baud	9600 Baud
Patient Mode	Neonate and Reserved	Neonate
SpO_2 Averaging	Slow, Normal, and Fast	Normal
ECG Synchronization	On and Off	Off
Line Frequency (Hertz)	50 and 60 Hz	60
Language	English, Deutsch, Español, and Français	English

** The computer or modem baud rate can be set at this time but will not have any significance until data can be retrieved from the internal compliance log memory. The retrieval of data stored in memory will be available in the near future.*

CALIBRATION

RECOMMENDED MAINTENANCE SCHEDULE

The Corometrics Model 510/511 Monitor is intended for SpO_2, heart rate, and respiratory rate real time monitoring and for the detection of central apnea when used in accordance with the Operator's Manual and when serviced, maintained, and tested in accordance with the following recommendations.

To ensure the continued safety and efficacy of your Model 510/511 Monitor, Corometrics recommends that the calibration, accuracy, and electrical safety of the monitor be verified on an annual basis. To arrange for this function, contact the Corometrics Service Department at one of the numbers below or send your monitor with a request for the annual calibration and safety check to the appropriate address below:

Inside the United States:
1-800-808-CORO (2676);
Corometrics Medical Systems Inc.
ATTN: Factory Service
61 Barnes Park Road North
Wallingford, CT 06492

Outside the United States:
(203) 265-5631;
or contact your local distributor

This service will be performed for a nominal fee.

FUNCTIONAL CHECKOUT PROCEDURE

Like all electronic monitoring devices, internal and external components are subject to fatigue, wear, and the potential for failure over time and under varying conditions of use. Additionally, events such as dropping the monitor, spilling liquids on the monitor, or crimping the leadwires or patient cable can cause damage which may affect overall system performance. Therefore, between service visits it is necessary that the proper operation of each monitor be verified by performing the Functional Checkout Procedure.

⚠ **IMPORTANT:** This procedure should be completed at least once a month, prior to initially placing the monitor in a home (Model 510 only), or more frequently as dictated by your equipment maintenance and management policies.

NOTE: The Model 510 Monitor Health Care Professional Instruction Manual (P/N 11274AA) and the Model 511 Monitor Operator's Manual (P/N 11275AA) should be used as references when the Functional Checkout Procedure is performed.

Patient Cables and Leadwires

Visually inspect the monitor, patient cable, leadwires and other accessories for cracks, fissures or other signs of wear or damage. Do not use any monitor or accessories that exhibit signs of excessive wear or damage.

Initiate the monitor full self-test procedure and test the patient cable and leadwires as described in Section 4, *Setup Procedures*.

The full self-test should be performed by the user at least once a day to verify that the monitor's visual and audible alarms function properly, the numerics are in the correct range (Model 511 only), and to confirm the integrity of the patient cable and leadwires. Do ***not*** use any monitor which fails the self-test or any accessory which appears worn or damaged. If unsure, contact the Corometrics Service Department to arrange for replacement or repair of the suspect item(s).

Monitor Alarms

The functional checkout procedure utilizes the Corometrics Model 500FS Simulator to verify that the Model 510/511 Monitor functions correctly in the basic alarm modes.

Set the monitor on a bench-top surface and connect the round end of the patient cable to the ECG/RESP port on the front panel of the monitor. Insert the female ends of the grabber leadwires into the flat, recessed male end of the patient cable. The white leadwire should be plugged in under the white dot, the black leadwire under the black dot, and the green leadwire under the green dot. Attach the grabber end of the leadwires to the Model 500FS Simulator. The white leadwire should be connected to the terminal on the top of the simulator marked "RA", the black leadwire to the terminal marked "LA", and the green leadwire to the terminal marked "RL". Testing can be completed using the monitor's internal battery or with the monitor's external AC power source/charger.

NOTE: The Model 500FS Simulator is battery powered. Ensure that the internal batteries are in good condition. Old or depleted simulator batteries may cause the monitor to fail the functional checkout procedure.

Heart Rate Low

Using the LCD control panel, located behind a hinged door on the bottom of the monitor, access the ALARM LIMITS configuration menu and set the alarm limits of the monitor to the following values:

HEART RATE HIGH = 240 BPM
HEART RATE LOW = 70 BPM
RESP RATE LOW = 15 BrPM
APNEA = 10 seconds

Set the simulator respiration BASE OHMS to 500 OHMS throughout all the monitor alarm tests. Set the other switches to the following values:

BASE DEVIATION = 0.5 OHMS
RESPIRATION RATE = 30 BrPM
ECG RATE = 100 BPM
mV OUTPUT = 0.25

Turn *on* the monitor and simulator and verify that the monitor self-test occurs. After the monitor self-test, verify that the heart rate and respiratory rate numerics (Model 511 only) and the flashing of the green heart and lung symbols correspond to the settings of the simulator.

In turn, set the monitor's HEART RATE LOW alarm limit to each of the values in the first column of Table 5-1. Change the ECG RATE as listed in the second column from the higher value to the lower value and verify that the numerics (Model 511 only) and audible and visual alarms respond as described in the remaining columns.

NOTE: To silence the HEART RATE LOW audible alarm change the ECG RATE back to the higher value given. Press the RESET pushbutton for the Model 510 or the RESET/MUTE pushbutton for the Model 511 to clear the LOW alarm indicator.

Table 5-1. Heart Rate Low Alarm Test.

MONITOR HEART RATE LOW ALARM SETTING (BPM)	SIMULATOR ECG RATE SETTING (BPM)	NUMERIC HEART RATE INDICATOR (Model 511 only) (± 2 BPM)	NUMERIC RESPIRATORY RATE INDICATOR (Model 511 only) (± 2 BrPM)	LOW HEART RATE VISUAL INDICATOR	AUDIBLE INDICATIONS
70	100	100	30	OFF	OFF
	60	60		ON	ON
80	100	100	30	OFF	OFF
	60	60		ON	ON
90	100	100	30	OFF	OFF
	60	60		ON	ON
100	150	150	30	OFF	OFF
	60	60		ON	ON

Heart Rate High

Set the alarm limits of the monitor to the following values:

HEART RATE HIGH = 110 BPM
HEART RATE LOW = 50 BPM
RESP RATE LOW = 15 BrPM
APNEA = 10 seconds

Set the simulator switches to the following values:

BASE DEVIATION = 0.5 OHMS
RESPIRATION RATE = 30 BrPM
ECG RATE = 100 BPM
mV OUTPUT = 0.25

Verify that the heart rate and respiratory rate numerics (Model 511 only) and the flashing of the green heart and lung symbols correspond to the settings of the simulator.

In turn, set the monitor's HEART RATE HIGH alarm limit to each of the values in the first column of Table 5-2. Change the ECG RATE as listed in the second column from the lower value to the higher value and verify that the numerics (Model 511 only) and audible and visual alarms respond as described in the remaining columns.

NOTE: To silence the HEART RATE HIGH audible alarm change the ECG RATE back to the lower value given. Press the RESET pushbutton for the Model 510 or the RESET/MUTE pushbutton for the Model 511 to clear the HIGH alarm indicator.

Table 5-2. Heart Rate High Alarm Test.

MONITOR HEART RATE HIGH ALARM SETTING (BPM)	SIMULATOR ECG RATE SETTING (BPM)	NUMERIC HEART RATE INDICATOR (Model 511 only) (± 2 BPM)	NUMERIC RESPIRATORY RATE INDICATOR (Model 511 only) (± 2 BrPM)	HIGH HEART RATE VISUAL INDICATOR	AUDIBLE INDICATIONS
110	100	100	30	OFF	OFF
	150	150		ON	ON
160	150	150	30	OFF	OFF
	200	200		ON	ON
230	150	150	30	OFF	OFF
	VARIABLE / MAX*	> 240		ON	ON
OFF	150	150	30	OFF	OFF

Resp Rate Low

Set the alarm limits of the monitor to the following values:

HEART RATE HIGH = 120 BPM
HEART RATE LOW = 50 BPM
RESP RATE LOW = 20 BrPM
APNEA = 10 seconds

Set the simulator switches to the following values:

BASE DEVIATION = 0.5 OHMS
RESPIRATION RATE = 60 BrPM
ECG RATE = 100 BPM
mV OUTPUT = 0.25

Verify that the heart rate and respiratory rate numerics (Model 511 only) and the flashing green heart and lung symbols correspond to the settings of the simulator.

In turn, set the monitor's RESP RATE LOW alarm limit to each of the values in the first column of Table 5-3. Change the RESPIRATION RATE as listed in the second column from the higher value to the lower value and verify that the numerics (Model 511 only) and audible and visual alarms respond as described in the remaining columns.

NOTE: To silence the RESP RATE LOW audible alarm change the RESPIRATION RATE back to the higher value given. Press the RESET pushbutton for the Model 510 or the RESET/MUTE pushbutton for the Model 511 to clear the LOW alarm indicator.

Table 5-3. Resp Rate Low Alarm Test.

MONITOR RESP RATE LOW ALARM SETTING (BrPM)	SIMULATOR RESPIRATION RATE SETTING (BrPM)	NUMERIC HEART RATE INDICATOR (Model 511 only) (± 2 BPM)	NUMERIC RESPIRATORY RATE INDICATOR (Model 511 only) (± 2 BrPM)	LOW RESPIRATION RATE VISUAL INDICATOR	AUDIBLE INDICATIONS
20	60	120	60	OFF	OFF
	15		15	ON	ON
25	60	120	60	OFF	OFF
	15		15	ON	ON
30	60	120	60	OFF	OFF
	15		15	ON	ON

Apnea

Set the monitor alarm limits to the following values:

HEART RATE HIGH = 240 BPM
HEART RATE LOW = 100 BPM
RESP RATE LOW = OFF
APNEA = 10 seconds

Set the simulator switches to the following values:

BASE DEVIATION = 0.5 OHMS
RESPIRATION RATE = 60 BrPM
ECG RATE = 150 BPM
mV OUTPUT = 0.25

Verify that the heart rate and respiratory rate numerics (Model 511 only) and the flashing green heart and lung symbols correspond to the settings of the simulator.

In turn, set the monitor's APNEA alarm limit to each of the values in the first column of Table 5-4. Change the BASE DEVIATION as listed in the second column from 0.5 to 0.1 OHMS and verify that after the appropriate amount of seconds the audible and visual alarms respond as described in the remaining columns.

NOTE: To silence the APNEA audible alarm change the BASE DEVIATION back to 0.5 OHMS. Press the RESET pushbutton for the Model 510 or the RESET/MUTE pushbutton for the Model 511 to clear the APNEA alarm indicator.

Table 5-4. Apnea Alarm Test.

MONITOR APNEA ALARM SETTING (SECONDS)	SIMULATOR BASE DEVIATION (OHMS)	LOW RESPIRATION RATE VISUAL INDICATOR	AUDIBLE INDICATIONS
10	0.5	OFF	OFF
	0.1	ON after 10 seconds	ON after 10 seconds
20	0.5	OFF	OFF
	0.1	ON after 20 seconds	ON after 20 seconds
30	0.5	OFF	OFF
	0.1	ON after 30 seconds	ON after 30 seconds

Probe

Set the alarm limits of the monitor to the following values:

HEART RATE HIGH = 240 BPM
HEART RATE LOW = 50 BPM
RESP RATE LOW = 15 BrPM
APNEA = 10 seconds

Set simulator switches to the following values:

BASE DEVIATION = 0.5 OHMS
RESPIRATION RATE = 30 BrPM
ECG RATE = 100 BPM
mV OUTPUT = 0.25

Verify that the heart rate and respiratory rate numerics (Model 511 only) and the flashing green heart and lung symbols correspond to the settings of the simulator.

SpO_2 Sensor Disconnect

To test the SpO_2 sensor disconnect probe alarm, plug the interface cable into the SpO_2 connector on the front panel of the monitor. Then, connect the sensor assembly to the interface cable. After probe connection, the numeric area will display two dashes (- -) (Model 511 only). After a lag period of a few seconds, the PROBE indicator will illuminate and the probe alarm will sound. Once this happens, disconnect the sensor assembly from the interface cable and verify that the PROBE indicator remains illuminated and the probe alarm still sounds. If the PROBE indicator does not remain illuminated and the probe alarm does not continue to sound the SpO_2 PROBE alarm is not functioning properly.

SpO_2 Interface Cable Disconnect

To test the SpO_2 interface cable disconnect probe alarm, plug the interface cable into the SpO_2 connector on the front panel of the monitor. Then, connect the sensor assembly to the interface cable. After probe connection, the numeric area will display two dashes (- -) (Model 511 only). After a lag period of a few seconds, the PROBE indicator will illuminate and the probe alarm will sound. Once this happens, disconnect the interface cable from the monitor and verify that the PROBE indicator remains illuminated and the probe alarm still sounds. Press the RESET pushbutton for the Model 510 or the RESET/MUTE pushbutton for the Model 511 to turn off the visual and audible alarms. If the PROBE indicator remains illuminated and the alarm still sounds the SpO_2 PROBE alarm is not functioning properly.

Lead Off

Disconnect either the white or black leadwire from the simulator. Verify that the LEAD OFF indicator illuminates and the audible alarm sounds after two seconds. Reconnect the leadwire to the simulator. When the audible alarm ceases, press the RESET pushbutton for the Model 510 or the RESET/MUTE pushbutton for the Model 511 to clear the LEAD OFF alarm indicator.

Internal Battery / Charging

Connect the monitor's AC power source/charger and verify that the CHARGING indicator illuminates. Initiate the monitor self-test procedure. Let the monitor run in the self-test mode for two minutes. After two minutes, detach the AC power source/charger from the monitor and verify that the CHARGING indicator extinguishes. The self-test should continue without interruption utilizing the internal battery. If the monitor turns off or the self-test is interrupted in any way the internal battery is not functioning properly.

TEST COMPLETION

Turn off the Model 510/511 Monitor and the 500FS Simulator. If the monitor failed any of the above monitor alarm tests, the monitor may require calibration or repair. Service should be performed only by a Corometrics Service Representative. To contact the Corometrics Service Department use one of the following numbers:

Inside the United States:
1-800-808-CORO (2676)

Outside the United States:
(203) 265-5631;
or contact your local distributor

REMOTE ALARM (MODEL 510 ONLY)

⚠ **WARNING:** Be aware of the auxiliary input/output cable and the remote alarm cable connecting the Model 510 monitor to the Model 501 remote alarm. Place the cables as far out of the way as possible so they are not easily tripped on.

The Corometrics Model 501 Remote Alarm may be used with the Model 510 Monitor to allow monitoring up to 100 feet from the baby. The remote alarm will indicate an abnormality with the baby (slow or fast heart rate, slow respiratory rate, central apnea, or low SpO_2) or with the monitor (loose lead, low battery, probe, error, or memory full) with a constant alarm sound and a solid ALARM indicator. It will also alarm if the monitor and remote alarm become disconnected from each other.

CONNECTION

To connect the Model 501 remote alarm to the Model 510 monitor plug the 50 pin end of the auxiliary input/output cable into the AUX. INPUT/OUTPUT receptacle on the back of the monitor. Connect the phono-jack end of the auxiliary input/output cable to either end of the remote alarm cable. Connect the other end of the remote alarm cable into the back of the remote alarm.

ON/OFF

To turn the remote alarm on, pull the ON/OFF switch out and flip it up. To turn the remote alarm off, pull the ON/OFF switch out and flip it down.

INDICATORS

The ALARM indicator will illuminate when a problem is indicated by the Model 510 monitor. The ALARM indicator will be extinguished when the problem is resolved.

The LOW BATTERY will illuminate when the battery of the remote alarm weakens. When the LOW BATTERY indicator illuminates, ***stop using the remote alarm*** and stay within hearing range of the Model 510 until the battery can be replaced.

TESTING THE REMOTE ALARM

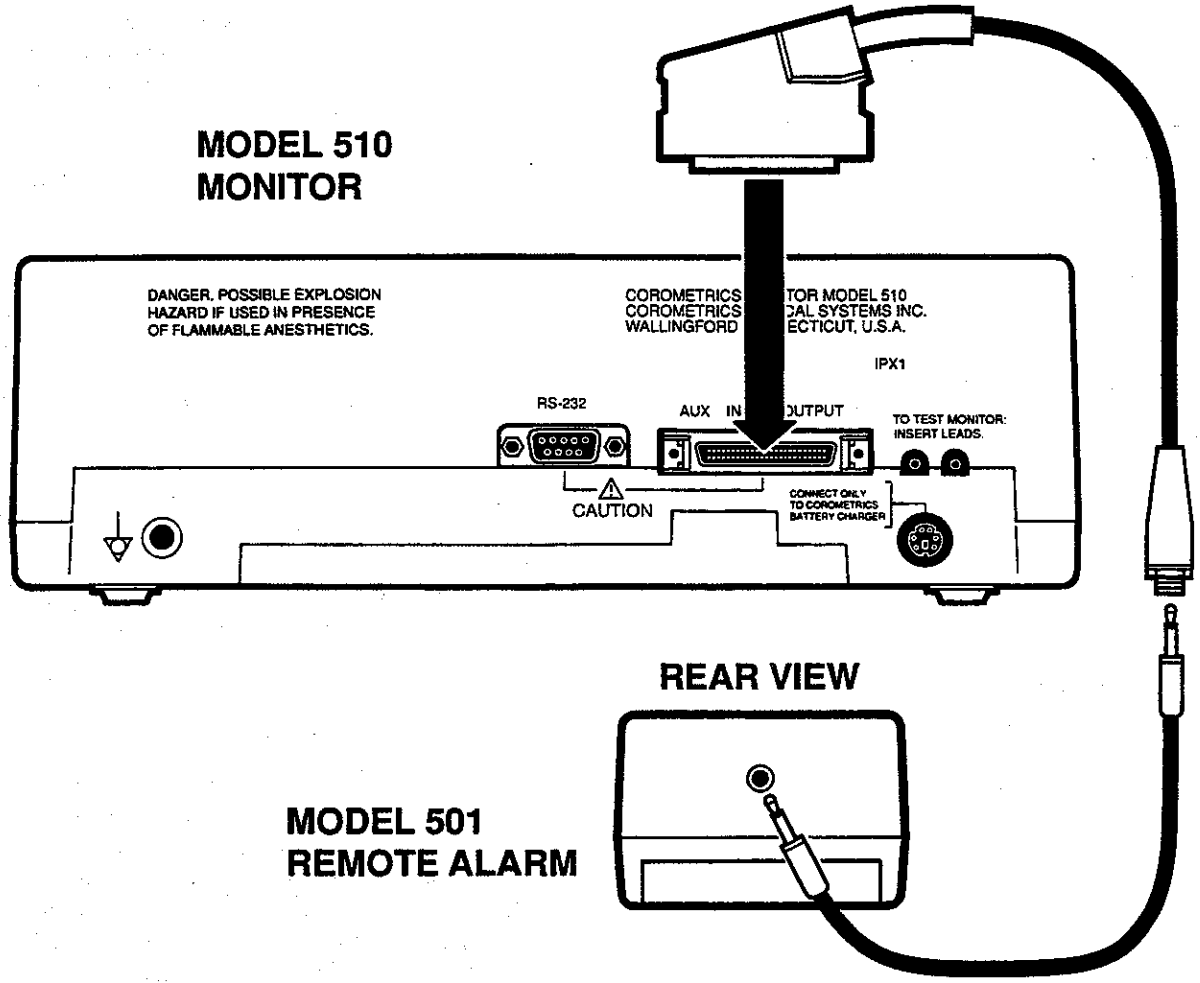
The remote alarm should be tested before each use to make sure it is working properly, the audio alarm sounds, the ALARM indicator illuminates, and the battery is not low. To test the remote alarm:

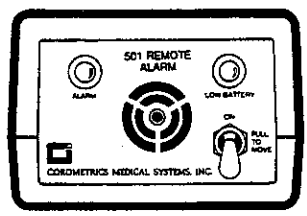
- connect the remote alarm to the Model 510 Monitor;
- turn the remote alarm and monitor on;
- disconnect the alarm from the monitor by unplugging the remote cable from the back of the remote alarm; and
- make sure the remote audio alarm sounds, the ALARM indicator illuminates, and the battery is not low. Ensure the audio alarm can be heard from the area where you will be.

  NOTE: Remote alarms other than the Corometrics Model 501 Remote Alarm will not work properly with the Model 510 and may damage the monitor.

BATTERY

The remote alarm is powered by a nine volt alkaline battery. A fresh battery should last longer than six months. Two types of batteries you may use are Duracell and Eveready. When the remote battery begins to weaken, the LOW BATTERY light on the remote alarm will illuminate and there will be a constant alarm sound. Do not use the remote alarm while a low battery condition exist. The battery may be changed by snapping off the battery cover on the bottom of the remote alarm and replacing it with a fresh battery.





MODEL 501
REMOTE ALARM

FRONT VIEW

CARRYING CASE (MODEL 510 ONLY)

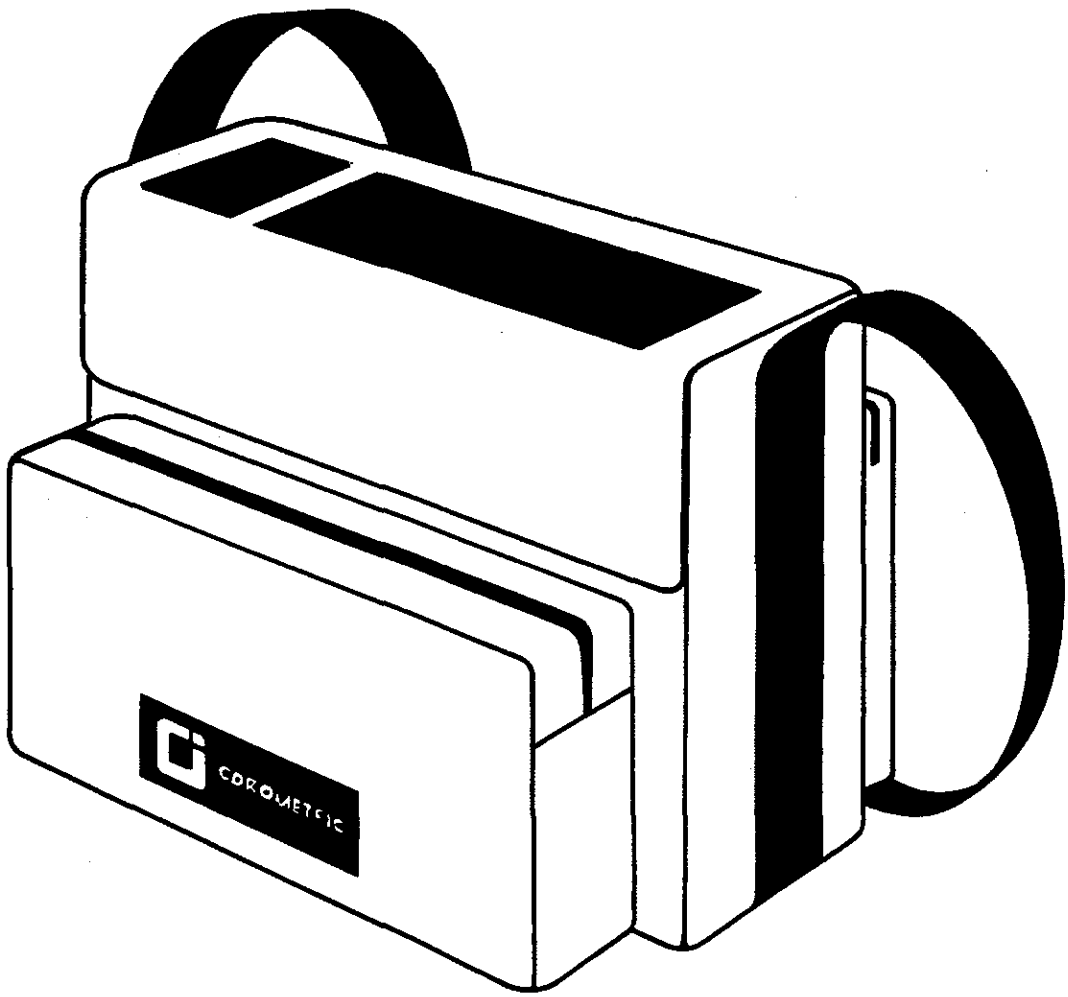
The Model 510 Monitor may be placed in the Corometrics Soft Carrying Case to protect it from damage and to make it easier to carry on trips.

To place the monitor into the case unplug the power source/ charger, patient cable, and Nellcor sensor interface cable from the monitor. Slide the monitor into the case so that the displays and indicators may be seen through the clear plastic when the top flap is closed.

Close the top flap of the case and ensure that the small round opening in the top flap lines up with the monitor's alarm speaker and the large open rectangle is lined up with the monitor's front panel connectors.

Plug the patient cable and Nellcor sensor interface cable into the front of the monitor through the rectangular opening in the top flap. The power source/charger may be plugged into the monitor through the opening in the bottom of the case.

The alarm sound will come through the round opening in the top flap. Do not put the monitor in a place where the alarm speaker opening could be blocked.



MAINTENANCE

⚠ **WARNING:** Do not open the monitor to clean or repair it.

PREVENTIVE MAINTENANCE

It is recommended that a routine maintenance check be implemented whenever a full self-test is performed on the monitor, patient cables, and leadwires. The routine maintenance check consists of a check of the overall appearance and physical condition of the monitor, accessories, and AC power source/charger for any obvious damage. A full self-test is recommended on a daily basis or whenever the patient cable and leadwires are changed. For instructions on how to perform the self-test, refer to Section 4, *Setup Procedures*.

The more detailed Recommended Maintenance Schedule and Functional Checkout Procedure should be performed prior to initial use and at least every six months thereafter. The Recommended Maintenance Schedule and Functional Checkout Procedure is detailed in Section 5, *Calibration*.

To ensure the continued safety and performance of the Model 510/511 monitor, Corometrics recommends that the calibration, accuracy, and electrical safety of the monitor be verified on an annual basis by a Corometrics Service Representative.

CLEANING THE MONITOR

⚠ **CAUTION:** Never clean the monitor when it is being operated. Unplug the monitor from the AC power source (make sure the monitor is *off* and not running off the internal battery) and detach all accessories from the monitor. Do not use abrasive cloth or cleaners on the monitor.

1. Wipe any fluids from the surface of the monitor.
2. Dampen a cloth or paper towel with a mild dishwasher detergent solution and gently rub soiled area until clean.

⚠ **CAUTION:** Do not clean the LCD with a mild dishwasher detergent solution; rub the lens that covers it with a soft, dry cloth.

CLEANING THE PATIENT CABLES AND LEADWIRES

⚠ **CAUTION:** Detach all accessories from the monitor. Do not immerse the accessories in any liquid. Do not use an abrasive cloth or cleaner on the accessories.

Immersing patient cables or leadwires in any liquid may result in internal damage and reduction of usage life. Also, using alcohol or other organic solvents to wipe patient cables and leadwires may draw the plasticizers from the product resulting in stiffness and brittleness.

Wipe patient cables and leadwires with warm soapy water. Cleaners or disinfectants other than warm soapy water have not been tested and cannot be recommended.

CLEANING THE REUSABLE ELECTRODES

Use a clean damp cloth to clean the reusable electrodes each day they are in use. Use of dishwasher soap should be avoided.

CLEANING THE ELECTRODE BELT

Wash the electrode belt gently with dishwasher soap and water. Do not clean in an automatic washer or dryer. The electrode belt should be completely dry before use.

CLEANING THE REUSABLE SpO_2 SENSORS

The Nellcor reusable sensors may be cleaned by wiping them with a disinfectant such as 70% alcohol.

⚠ **CAUTION:** Do not sterilize the reusable sensors by irradiation, steam, or ethylene oxide gas. Do not immerse the sensors in water or cleaning solutions.

CLEANING THE CARRYING CASE (MODEL 510 ONLY)

Wash the carrying case with dishwashing soap and a clean damp cloth. Do not place the carrying case in water or use an automatic washer or dryer.

SPECIFICATIONS*

MODEL 510/511 MONITOR

External Power Supply/Charger

Input:	100/120 VAC ± 10%, 50/60 Hz, .36 A	220/240 VAC ± 10%, 50/60 Hz, .18 A
Output:	17 VDC ± 20%, 1.2 A	17 VDC ± 20%, 1.2 A

Environmental Conditions

	Operating	Storage
Ambient Temperature:	32°F to 104°F (0°C to 40°C)	-4°F to 158°F (-20°C to 70°C)
Relative Humidity:	10% to 85%, non-condensing	10% to 85%, non-condensing
Atmospheric Pressure:	508–780 mmHg	Not Applicable

Physical Characteristics

Height:	3.25 in (8 cm)
Width:	10.0 in (25 cm)
Depth:	8.25 in (21 cm)
Weight	
with SpO_2:	7.3 lbs (3.31 kg)
without SpO_2:	6.76 lbs (3.07 kg)

ECG

Bandwidth:	1.6 to 40 Hz
Sensitivity Adjustment:	Automatic
Minimum Signal	
Infant mode:	0.15 mV peak-to-peak
Common Mode Rejection:	> 100 dB with 5K lead imbalance
Input Offset Tolerance:	± 300 mV
Noise:	≤ 50 µV peak-to-peak, 1 to 100 Hz
Loose Lead Threshold:	2.0 to 2.5 kΩ, 2 second delay
Signal Detection	
Transthoracic:	Two leadwires (RA - LA)
Optional ground:	One leadwire (RL or LL)
Pacemaker spike rejection:	Meets AAMI Standards
Lead Length:	24 or 36 inches
Electrodes:	Disposable or reusable (carbon)
QRS Beep (Model 511 only):	Adjustable volume
Input impedance:	> 2.5 MΩ differential at 10 Hz > 10.0 MΩ common mode at 60 Hz

Heart Rate

Asystole detection	
Infant mode:	5 seconds
Alarms:	User-selectable: low heart rate and high heart rate
Alarm Delay Time:	None
Numeric Resolution:	1 BPM
Accuracy:	±3 BPM
Analog Output:	-2 to +2 VDC, 0 to 350 BPM

** Specifications subject to change without notice.*

Heart Rate Numeric*	
Infant mode:	10 to 350 BPM Averaged, 1 second update
Computation method*	
Trace:	Beat-to-beat
Numeric:	Averaged over 150 beats

Respiration

Bandwidth:	0.2 to 2.5 Hz
Sensitivity Adjustment:	Automatic
Triggering Levels:	Minimum trigger at .15 Ω, at 50 BrPM and HR at 150 BPM
Respiration Rate Numeric*:	0 to 180 BrPM Averaged, 1 second update
Numeric Resolution:	1 BrPM
Alarms:	User-selectable: low respiration rate and apnea delay
Detection Technique:	Impedance Pneumography
Artifact Rejection:	CVA Filter removes cardiogenics before breath detection
Sense Current/Frequency:	250 µA at 28 kHz
Base Impedance Range:	0 to 2.7 kΩ at 28 kHz (neonate)
Noise:	< 10 MΩ RMS 0.1 to 100 Hz
Gain:	1.25 V/Ω at 1.0 Ω peak-to-peak, 30 BrPM

Pulse Oximetry (performance in accordance with Nellcor MP-203)

Technique:	Spectrophotometry and plethysmography
Probe type:	Nellcor types listed in *Section 6*
Saturation Range:	30% to 100%
Saturation Accuracy (%SpO_2 ±1 standard deviation†)	
Nellcor N-25 (neonate):	70–95% ±3 digits or %
Wavelengths:	660 nm (red, nominal) and 920 nm (infrared, nominal)
Alarms:	User-selectable: low SpO_2
%SpO_2 Numerics*:	30–100
Pulse Rate Range:	20–250 BPM (stored in memory card when selected)
Pulse Rate Accuracy:	±3 BPM
Pulse Rate Displayed Numerics:	None

Safety Characteristics

Chassis to ground:	50 µA maximum leakage
Patient Lead to ground:	10 µA maximum leakage
Line Transient Protection:	±50% step, 0.5 second minimum
Defibrillator Protection:	Recovery time 2 seconds

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* *Numerics are displayed on the Model 511 only.*

† *The accuracy of a given oxygen range is valid for only 68% of the data points taken and the remaining 32% of the data points are not accounted for in the specification.*

Battery Power

Type:	Sealed Lead Acid Rechargeable, 6 V @ 7.2 AH
Charge Time:	8 Hours continuous wall time for 90% capacity
Operating Time (fully charged without external input)	
Model 510 with SpO_2:	10.5 Hours
Model 510 without SpO_2:	24 Hours
Model 511 with SpO_2:	7.5 Hours
Model 511 without SpO_2:	15 Hours

External Connections

Battery Charger:	6 pin miniature circular DIN
RS-232:	9 pin miniature "D"
Aux. Input/Output:	50 pin Amplimite .050 series
Monitor Test:	2 pin type (.08 in or 2 mm)
ECG/Resp:	5 pin DIN
SpO_2:	10 pin Hypertronics type

Analog Outputs

Protection:	Short Circuit, indefinitely
Output impedance:	< 1 kΩ
Output voltage:	-2.0 VDC to +2.0 VDC

Indicators

Visual viewing angle:	Up to 45 degrees
Audio alarm frequency:	3.0 kHz ±10%
Audio Alarm volume	
Model 510:	85 dB minimum
Model 511:	Variable, 70 dB to 85 dB minimum at 1 m
QRS beep frequency:	1.5 kHz ±10%
QRS beep volume (Model 511 only):	Variable, 0 dB to 80 dB at 1 m
QRS detection LED:	100 milliseconds ON time per capture
Breath detection LED:	100 milliseconds ON time per breath